**Standards/Targets**

TN Science

**SPI 0507.10.2** Use data from an investigation to determine the method by which heat energy is transferred from one object or material to another.

ISTE NETS-S

**3.d**. **Research and Information Fluency**

* Students apply digital tools to gather, evaluate, and use information.
  + Students process data and report results.

**Materials (per group)**

* 1 - light bulb and holder
* 2 – wires with clips
* 2 – battery holders
* 1 – Computer with Logger Lite or Logger Pro program
* 1 – Vernier Temperature Probe with Go!Link Interface
* Journals for anecdotal data
* (Optional) A block or foam shape to steady probe

**Job Descriptions**

**Computer Tech** – Operates computer and programs

**Probe Handler** – Is in charge of a Vernier temperature probe; Holds by handle at all times (builds circuit on smaller teams)

**Supervisor** – Makes sure others understand what to do; Positively corrects group members

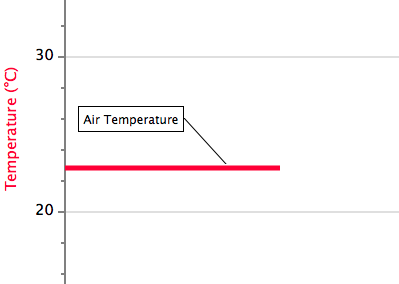
**Electrical Engineer** – Builds and maintains the circuit

**Set**

1. Assemble into 2-4 member teams
   1. 2 person teams – Computer Tech and Probe Handler
   2. 3 person teams – Computer Tech, Probe Handler, and Supervisor
   3. 4 person teams – Computer Tech, Probe Handler, Supervisor, and Electrical Engineer
2. Pass out box with supplies per group.
3. Assign and describe jobs to students. Explain that they will rotate through all jobs during the activity

Question – If you were building a personal heating device, which would be the best method to use – conduction, convection, or radiation?

**Process (Team member responsible for that task is listed in parentheses.)**

1. Build simple circuit with light bulb, batteries in a case, and 2 wires. **(Probe Handler or Electrical Engineer)** This will allow the heat to build while working on next steps.
2. Turn on computer and launch the Vernier Logger Lite or Logger Pro application **(Computer Tech).**
3. Assemble and attach the temperature probe. **(Probe Handler)**
4. Record air temperature 1 foot away from the bulb.
   1. **Computer Tech** clicks the COLLECT button while the **Probe Handler** holds the temperature probe by only the black plastic handle.
   2. After 30 seconds of data is collected, **Computer Tech** clicks the STOP button.
5. Store and label the data. **(Computer Tech)**
   1. Click the STORE button in toolbar.
   2. Click INSERT menu and choose “Text Annotation”.
   3. Type “Air Temperature” in text box.
   4. Drag box and pointer to line graphed by room temperature air.
6. Ask groups what line in the graph means about the temperature in the room. Discuss and record into the STEM journals.
7. Zoom to data with the AUTOSCALE button . **(Computer Tech)**
8. Discuss the new range shown on left and how it changes the graph.
9. Rotate positions and jobs.
10. Record and store data for temperature **beside** the bulb.
    1. **Probe handler** places tip of probe about a pencil’s thickness from right side of bulb while the **Computer Tech** clicks the COLLECT button. **Probe handler** may use an optional block to support/steady the tip of the probe.
    2. **Supervisor** helps to coach the **Probe handler** to remain steady.
    3. After 30 seconds of data is collected, **Computer Tech** clicks the STOP button, and then clicks the STORE button.
    4. **Computer Tech** clicks INSERT menu and chooses “Text Annotation”, then types “Beside Bulb” in text box, and drags box and pointer to new line graphed.
11. Discuss the new data shown and record into STEM Journal.
12. Rotate positions and jobs.
13. Record and store data for temperature **above** the bulb.
    1. **Probe handler** places tip of probe about a pencil’s thickness above of bulb while the **Computer Tech** clicks the COLLECT button. **Probe handler** may use an optional block to support/steady the tip of the probe.
    2. **Supervisor** helps to coach the **Probe handler** to remain steady.
    3. After 30 seconds of data is collected, **Computer Tech** clicks the STOP button, and then clicks the STORE button.
    4. **Computer Tech** clicks INSERT menu and chooses “Text Annotation”, then types “Above Bulb” in text box, and drags box and pointer to new line graphed.
14. Discuss the new data shown and record into STEM Journal.
15. Rotate positions and jobs.
16. Record and store data for temperature **touching** the bulb.
    1. **Probe handler** places tip of probe on the bulb while the **Computer Tech** clicks the COLLECT button. **Probe handler** may use an optional block to support/steady the tip of the probe.
    2. **Supervisor** helps to coach the **Probe handler** to remain steady.
    3. After 30 seconds of data is collected, **Computer Tech** clicks the STOP button, and then clicks the STORE button.
    4. **Computer Tech** clicks INSERT menu and chooses “Text Annotation”, then types “Touching Bulb” in text box, and drags box and pointer to new line graphed.
17. Discuss the new data shown and record into STEM Journal. Focus on which readings came from heat transferred through conduction, which came from convection, and which came from radiation.
18. **Computer Tech** click FILE menu and choose PRINT GRAPH.
    1. Make sure “Print Footer” is checked.
    2. Type “Heat Transfer” and names of group members into NAME: box.
    3. Click OK.
    4. Change number in Copies: box from 1 to number of members of group.
    5. Click PRINT button.
19. **Supervisor/Computer Tech** goes to the printer to collect the copies for the group.
20. All members add to their STEM Journal.
21. Clean up
    1. **Computer Tech** quits Logger Lite or Logger Pro application. (Saving data is optional.)
    2. **Probe handler** disassembles probe and folds probe cables for storage. Be sure they are NOT wrapped around the probe or GO!Link.
    3. **Electrical Engineer/Supervisor** disassembles the light circuit for storage.

The graph created will look similar to below.

